QUANTITATIVE INDUSTRIAL HYGIENE

A Formula Workbook

JACK CARAVANOS, DrPH, CIH

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QUANTITATIVE INDUSTRIAL HYGIENE:

A FORMULA WORKBOOK

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In Loving Memory of

George J. Kupchik, Dr. Eng. Sc.

founder of the Hunter College
Environmental and Occupational Health Program,
mentor and friend

TABLE OF CONTENTS

Page

- **Preface** 4
- **Using the Workbook** 6
- **Significant Figures and Rounding off Numbers** 9
- **Abbreviations and Symbols** 10

1. Industrial Hygiene Chemistry

Listing of Formulas and Concepts 11
a. Chemical Equations, Production of Moles and Grams 13
b. pH Calculations 15
c. Specific Gravity Calculations 16
d. Parts per Million Calculations 17
e. Parts per Million from Vapor Pressure Data 18
f. Calculating Milligrams per Cubic Meter 19
g. Parts per Million from/to Milligrams per Cubic Meter 20
h. Pressure and Volume Calculations – Boyle's Law 21
i. Volume and Temperature Calculations – Charles' Law 22
j. Pressure, Volume, Temperature Calculations 23
k. Particle Settling – Stokes' Law 24
l. Settling Rates of a Vapor 25
Problem Set 27
Answers to Problem Set 31

2. Air Sampling

Listing of Formulas and Concepts 37
a. Sampling Rate Calculations 39
b. Minimum Sampling Volume 40
c. Calculating Air Levels from Sampling Data – Vapors 41
d. Calculating Air Levels from Sampling Data – Dusts 42
e. Fiber Counting (Asbestos) using a Graticule 43
f. Calculating Time-Weighted Averages (TWA) 45
g. Calculating Threshold Limit Values (TLV) for Liquid Mixtures 46
h. Calculating TLVs for a Mixture of Airborne Contaminants 48
i. Calculating TLVs for Samples Containing Silica 49
Problem Set 51
Answers to Problems 55

3. Industrial Ventilation & Engineering Controls

Listing of Formulas and Concepts 59
a. Total, Static, and Velocity Pressure Calculations 62
b. Hood Static Pressure Calculations 63
c. Air Flow, Velocity, and Area Calculations 64
d. Air Changes per Hour 65
e. Air Flow Calculations from Pressure Readings 66
f. Air Flow in Ducts 67
g. Coefficient of Entry of Hoods 68
h. Fan Speed and Air Flow 69

i. Fan Speed and Fan Static Pressure 70
j. Fan Speed and Horsepower 71
k. Air Flow into a Plain Round or Square Hood 72
l. Air Flow into a Flanged Round or Square Hood 73
m. Air Flow into a Free-Standing Slotted Hood 74
n. Air Flow into a Flanged Slotted Hood 75
o. Air Flow into a Canopy Hood 76
p. Dilution Ventilation for Gases and Vapors 77
q. Dilution Ventilation – Volatile Liquid Generation 78
r. Dilution Ventilation – Fire/Explosion Hazards 79
s. Dilution Ventilation – Steady-State Conditions 81
Problem Set 83
Answers to Problem Set 87

4. Noise
Listing of Formulas and Concepts 93
a. Sound Power Level Equation 95
b. Sound Pressure Level Equation 96
c. SPL from Identical Sources 97
d. SPL from Different Sources - General Method 98
e. SPL from Different Sources - Tabular Method 99
f. SPL as a Function of Distance from a Point Source 100
g. Calculating Hearing Protector Attenuation 101
h. Calculating OSHA Permissible Noise Levels 102
i. Calculating Daily Noise Dose (DND) 103
j. TWA Equivalent from Noise Dose Measurements 104
k. Calculating Axial Blade Sound Frequencies 105
Problem Set 107
Answers to Problem Set 110

5. Ionizing and Non-Ionizing Radiation
Listing of Formulas and Concepts 117
a. Rate of Radioactive Decay 119
b. Half-Life Calculations 121
c. Dose Calculations from Radiological Data 122
d. Calculating REM 123
e. Inverse Square Law for a Point Source 124
f. Shielding: Half-Value Layer Method 125
g. Wavelength and Frequency (Hertz's) Determination 126
h. Far Field Power Density 127
i. Optical Density 128
Problem Set 129
Answers to Problem Set 132

6. Heat Exposure
Listing of Formulas and Concepts 137
a. Wet Bulb Globe Temperature – Indoors 139
b. Wet Bulb Globe Temperature – Outdoors 140
c. Calculating Time-Weighted Averages (TWA) 141
d. Effective Temperature Determination 142
e. Temperature, Humidity and Dew Point –Psychrometric Chart 143
f. Radiant Heat Transfer 145
g. Convective Heat Transfer 146
h. Metabolic Heat Generation 147
i. Required Rate for Evaporation of Sweat 148

j. Maximum Evaporative Capacity 149
k. Heat Stress Index – Formula Method 150
l. Heat Stress Index – Nomograph Method 152
m. Predicted 4 Hour Sweat Rate (P_4SR) 155
Problem Set 157
Answers to Problem Set 160

7. Statistics
Listing of Formulas and Concepts 163
a. Arithmetic Mean 165
b. Geometric Mean 166
c. Standard Deviation 167
d. Geometric Standard Deviation 168
e. Confidence Limits - Continuous Sampling 169
f. Confidence Limits - Consecutive Sampling 170
g. Rejecting a Suspect Value – Q Test 172
h. Comparing Means (t-Test) 173
Problem Set 177
Answers to Problem Set 179

8. Algebra Review
Basic Algebra Formulas 183
Examples of Solving Algebraic Calculations 184
Problem Set 191

APPENDIX
A. Volume, Mass and Length Conversions and Units; Other Related Formula 193
B. Atomic Symbols and Molecular Weights 195
C. Radiological Health Data 197
D. Critical Values of *t* 199
E. Occupational Standards and Miscellaneous Physical Values 201

BIBLIOGRAPHY 213

PREFACE

Industrial hygiene is usually defined as the identification, evaluation and control of workplace hazards. It is a multidisciplinary science which requires training in chemistry, biology, physics and health sciences. Course work in air sampling, noise, radiation, toxicology and other specialties are also essential. The general principles of industrial hygiene are adequately presented in a variety textbooks and reference manuals. This book focuses on the quantitative and calculational aspects of industrial hygiene.

The author felt the need for such a book when he was studying for his certification examination in industrial hygiene. While this workbook was originally written as a handout for graduate students in the Environmental and Occupational Health Sciences Program at Hunter College, it can be used by practicing industrial hygienist either as a reference or review book. That is, it can be a handy reference guide for the more common industrial hygiene formulas and/or it may be useful as a preparatory manual for the American Board of Industrial Hygiene core and comprehensive industrial hygiene certification examinations. Essentially, this book is designed to assist in the understanding and application of the many industrial hygiene formulas and relationships. Given the numerous formulas with which the hygienist must be familiar with, this book seeks to assist other professionals by gathering a large number of formulas in one place. While every effort was made to provide a comprehensive listing of formulas, numerous advanced formulas and derivations were intentionally left out. For the more advanced, a bibliography has been provided to assist in obtaining these formulas and relationships.

All problems presented in this book are original and attempt to simulate real-life situations and calculations, such as chemical exposure and sampling situations. In addition, many problems, both in the main text and the problem sets seek to identify important chemical, physical, or industrial hygiene principles.

Several important industrial hygiene topics have not been included in this book, i.e., toxicology, air pollution, occupational health regulations, personal protective equipment, and ergonomics. The topics presented in this workbook are limited to the more common quantitative topics of industrial hygiene. However, even these

topics are not presented completely. Basic chemical and physical principles, limitations of the formulas, and general industrial hygiene practice can only be mastered through a combination of experience and education. For example, mastering of the radiation formulas in this text does not ensure a complete and proper understanding of radiation science. If you are unfamiliar with the terms and concepts presented in a particular section, go back and read up on that topic in one of the standard industrial hygiene textbooks. Simply mastering the formulas is not enough.

Many people assisted in the development of this workbook. My sincere gratitude goes to the Program Director of the Environmental and Occupational Health Program at Hunter College; Professor David Kotelchuck. His encouragement and support together with his careful review and suggestions were invaluable. In addition several colleagues and friends donated their time in verifying the hundreds of calculations. Appreciation goes to Professors James Fahey and Mark Goldberg. A special thanks also goes to Mitchell Rosen and the staff at the training center of the Environmental and Occupational Health Sciences Institute at the University of Medicine and Dentistry of New Jersey. His support and helpful ideas together with the use of facilities made this project possible. I would also like to thank Sharon Ziegler of ACGIH of for the many valuable suggestions and continuing support provided throughout. Finally, this book would not be possible without the loving support and encouragement of my wife, Dr. Laureen MacEachern.